Progress Report on the Dual-Use Cryostat

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EDM collaboration meeting
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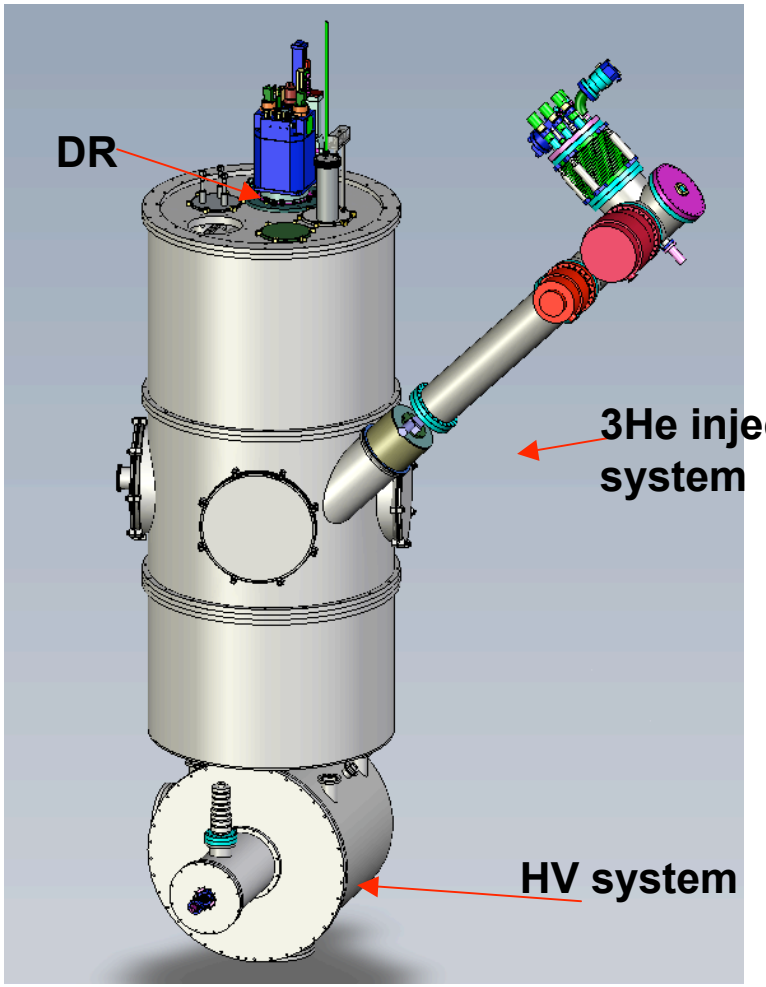
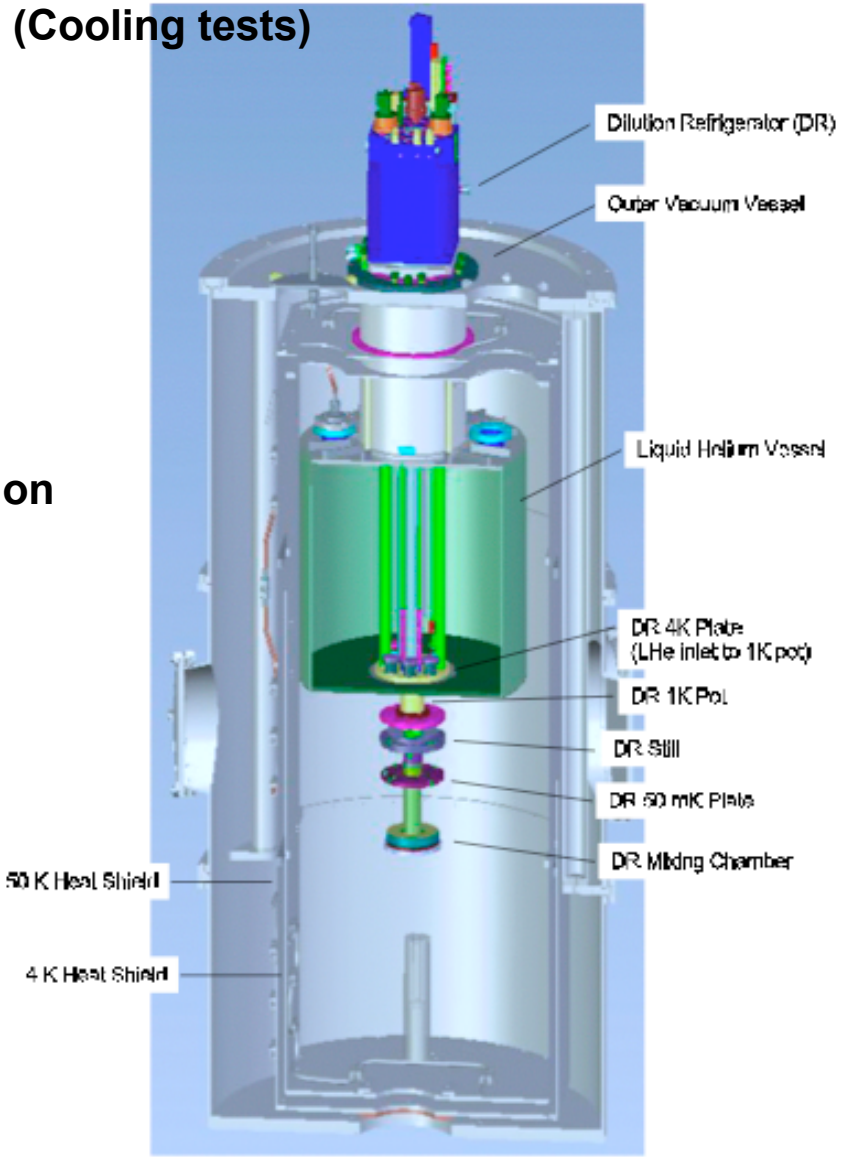
Dual-Use Cryostat (overview)

Full assembly (DR, HV, 3He)



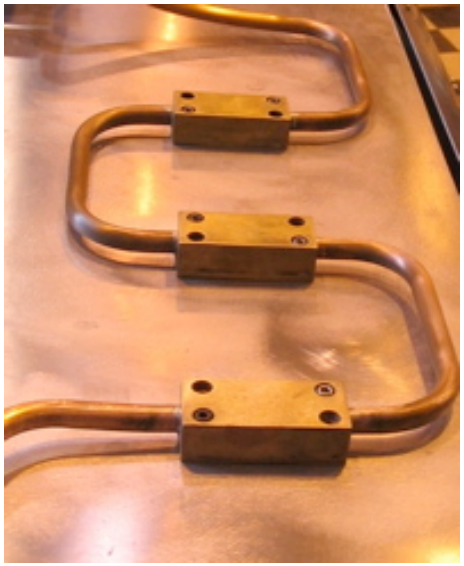
(Cooling tests)



E-Drawing files courtesy of John Ramsey

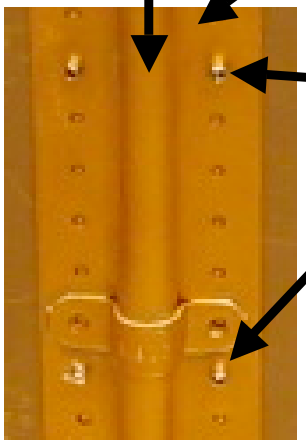
New design of heat shield cooling lines

- In Feb, we decided to change the design of heat shield cooling lines.
- New cooling line has much fewer solder joints than the old design. (The # of joints decreased by more than 100.) That eliminates the risk of potential leak during the experiments significantly.
- Copper refrigeration tubings are attached directly on the heat shield panels.
- Solder material used: Aladdin 450 (which contains Tin and Silver)



OLD

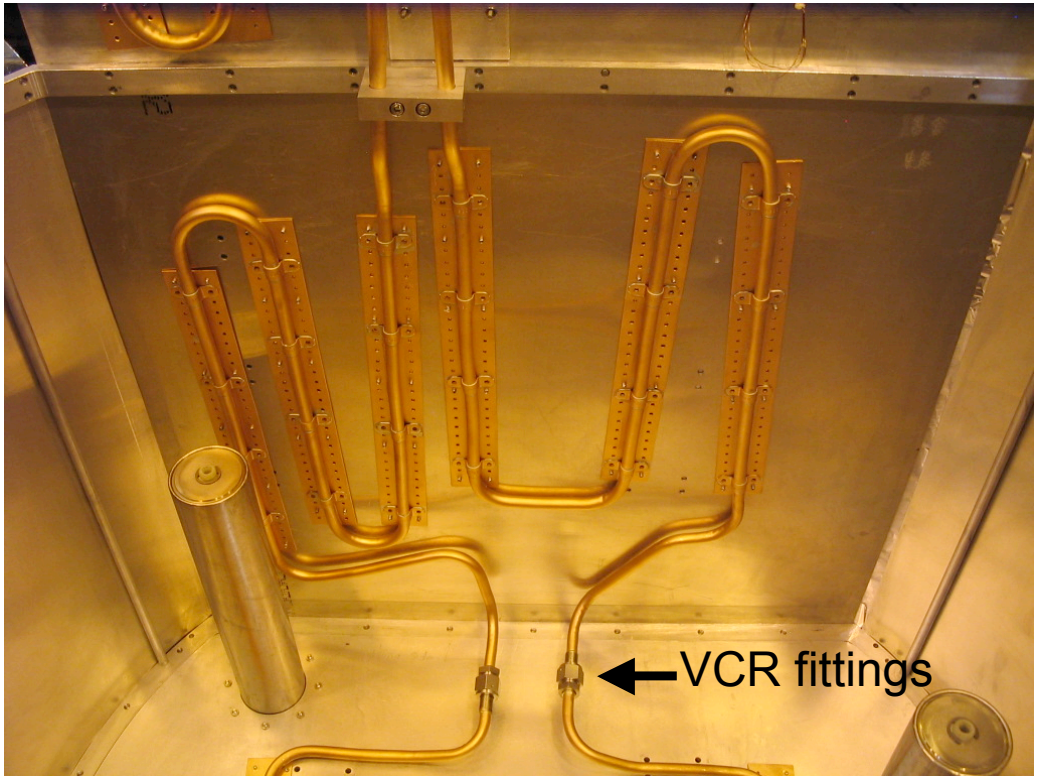
NEW



(enlarged)

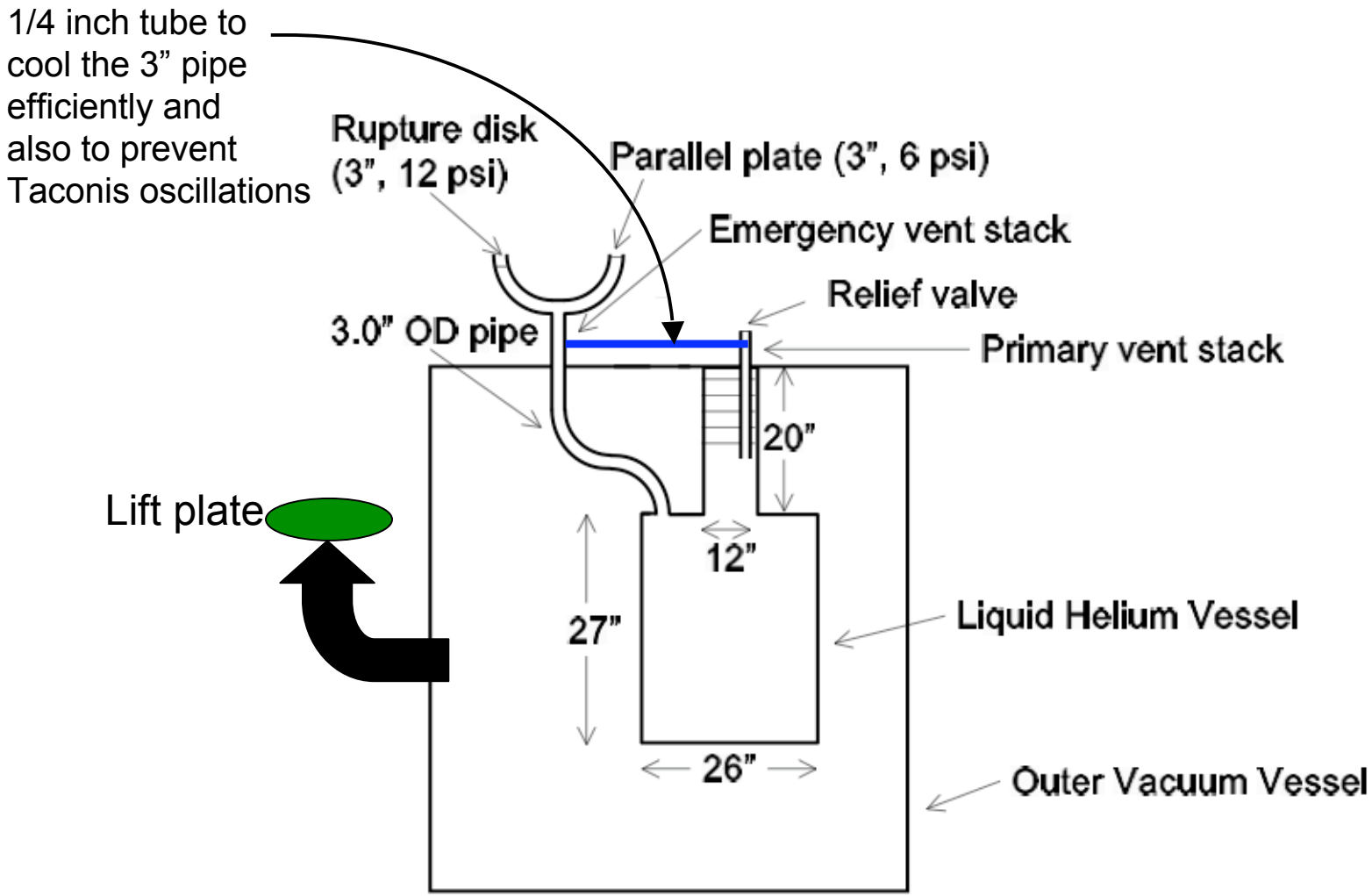
Work on new cooling lines

- Took us about 1.5 month to make and install cooling lines
- Many processes were involved (bending tubes, soldering [VCR, copper plate], drill holes, test mounting the cooling lines, cleaning [bead blasting, plasma, alcohol], installation with rivet pins)



Heat shield panel (4k, bottom) and Cooling line

Pressure relief systems for helium dewar and vacuum chamber



Pressure test for the cryostat vacuum chamber

- Required to do pressure test to obtain an approval of our safety document
- Need to see if our cryostat vacuum chamber can hold the 15psi internal pressure at which the lift plate installed on the chamber will open.

- Added more clamps on the side flanges
- The vacuum chamber was pressurized in 1 psi increment, until 15 psi with dry nitrogen gas. Wait for 10min after each increment to observe any pressure decrease. This cycle was repeated twice.
- No gross leaks and no obvious deformations were observed on the chamber during the test --> Success!

Pressure test done
on Apr 2, 2008 at LANL

Safety Document

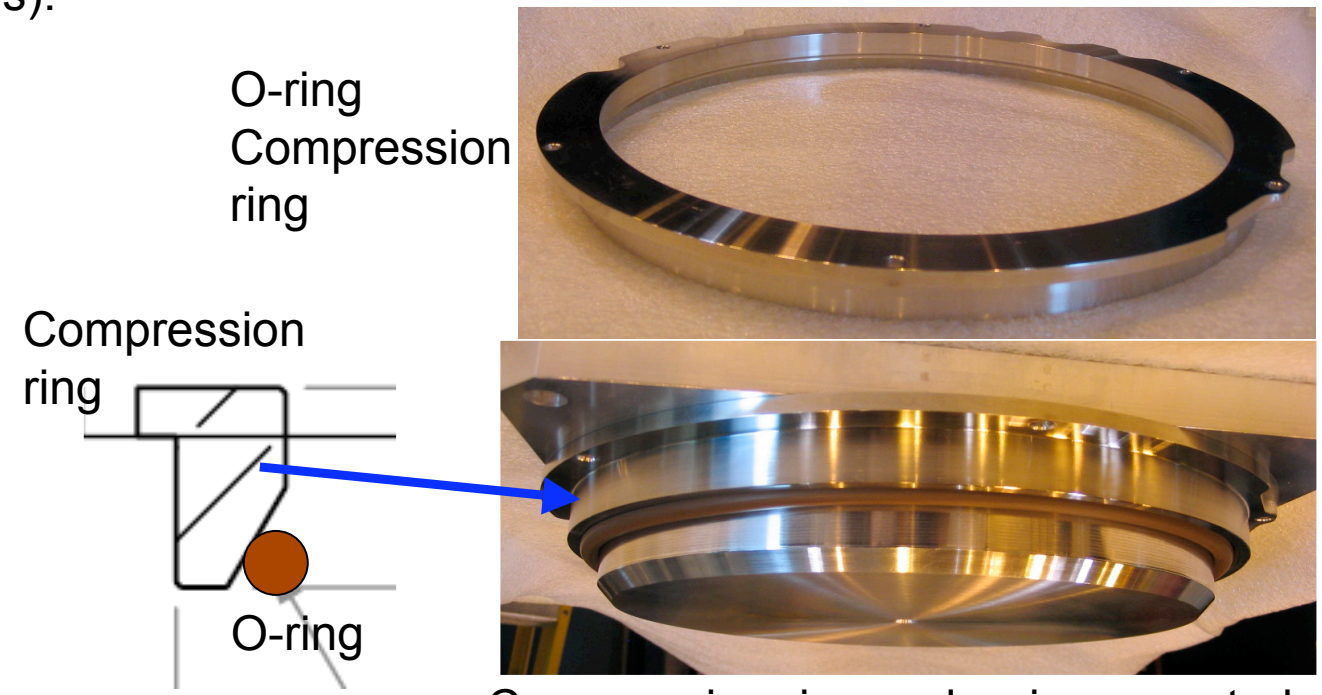
- Our safety document for the cooling tests, “nEDM Dual Use Cryostat Design Document”, written by T. Ito et al, was approved by the LANL pressure safety expert in early April.

- List below are some of the chapters in the document:
  - Safety considerations
  - Strength calculations (FEM)
  - Boiloff Rate in the Liquid Helium Vessel in Loss of the Isolation Vacuum
  - Rate of Pressure Rise in the Outer Vacuum Vessel in the Event of a Rupture of a Liquid Helium Containing Volume

- This document is available at twiki: https://nedm.bu.edu/twiki/bin/view/NEDM/DualUseCryostatDesign

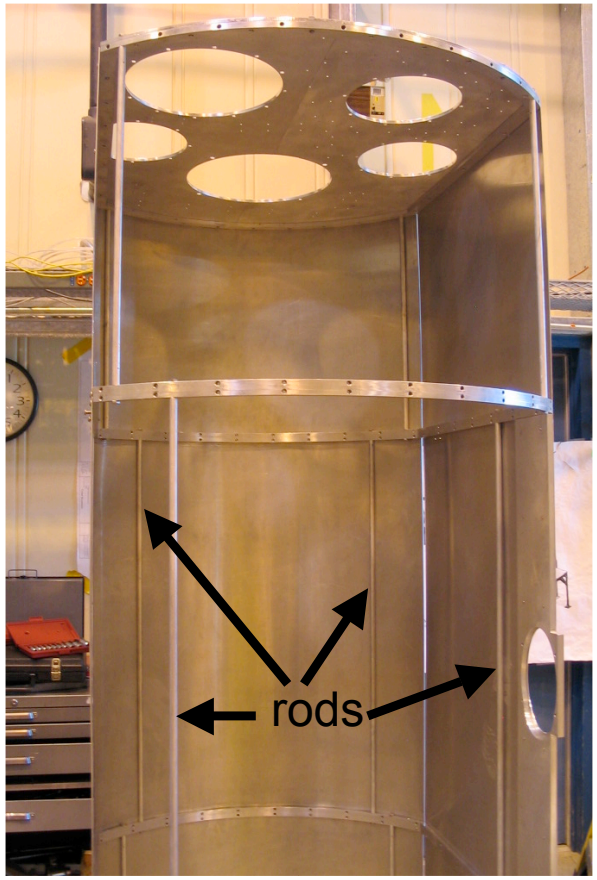
New design of o-ring compression ring

- The original seal for the DR top assembly has cracks but we are unable to get a replacement !
- We designed a new compression ring that works with o-ring.
- We installed this ring and o-ring in the top assembly and performed leak check on the LHe dewar. Found no leak (Leak detector flow rate ~ 10^-9 mbar l/s).



Compression ring and o-ring mounted on the DR top blank-off

Heat shield support rods



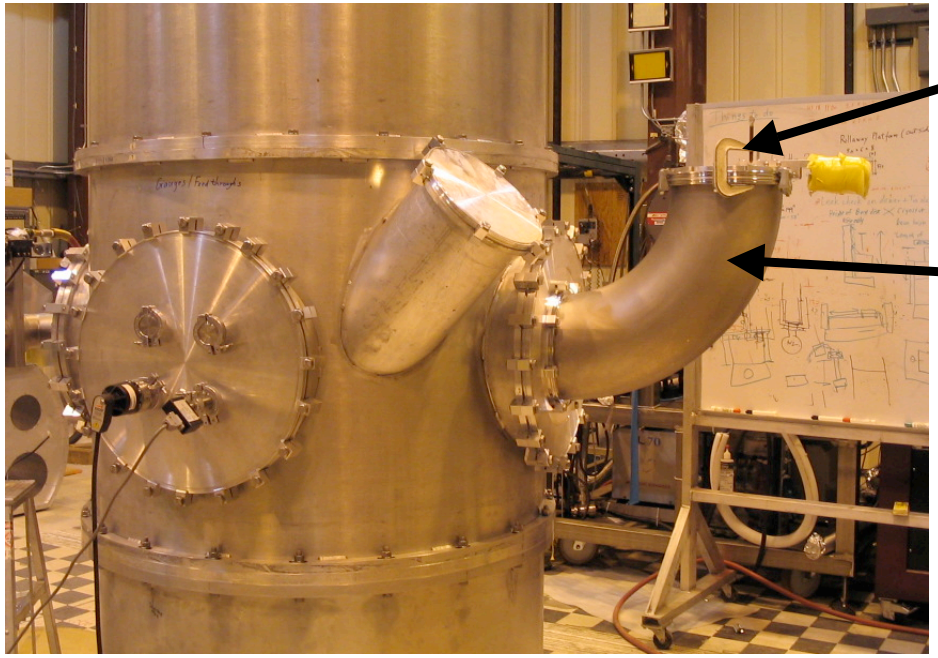
- We decided to make the heat shield support rods to stabilize the heat shields.
- Installation of heat shield panels becomes much easier.
- 4 rods were installed on each of the three sections (total 12 for each heat shield).

Other things completed

1. All of the MLI blankets for the 50k heat shield were made.
2. Decided to make the MLI blankets for 4k heat shield as well. 4k blanket has four layers of mylar sheets. All of them were made.
3. Wiring for the temperature sensors (total 18 of them) was done. Test installing them on the heat shield panels. Glued the temperature sensors using Stycast 2850.
4. Velcros for the MLI blankets and D-sub connectors are glued on the heat shield panels using stycast 1266.

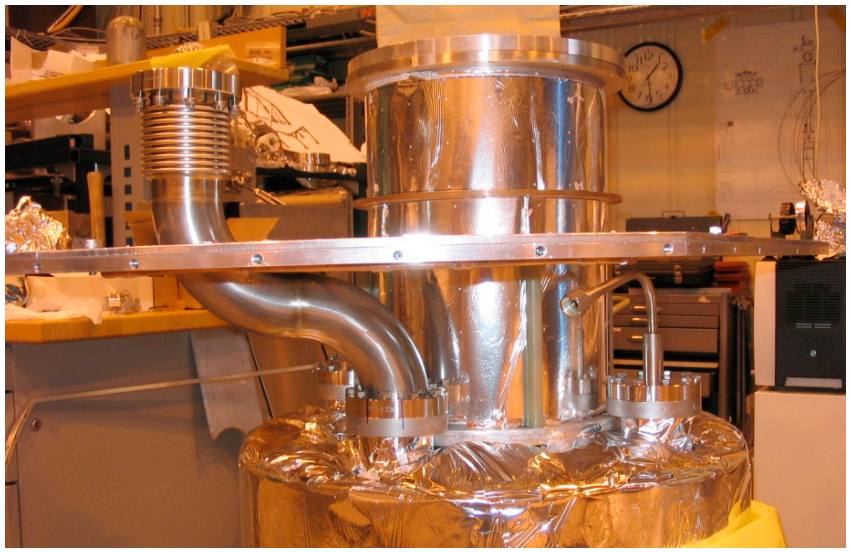
Assembling the cryostat (1)
Installation of the lift plate and elbow pipe

- Lift plate and 10” elbow pipe were installed to the cryostat vacuum chamber.
- Assembled the outer chamber and performed leak check. Found no leak.



Assembling the cryostat (2)
Test fitting of the dewar

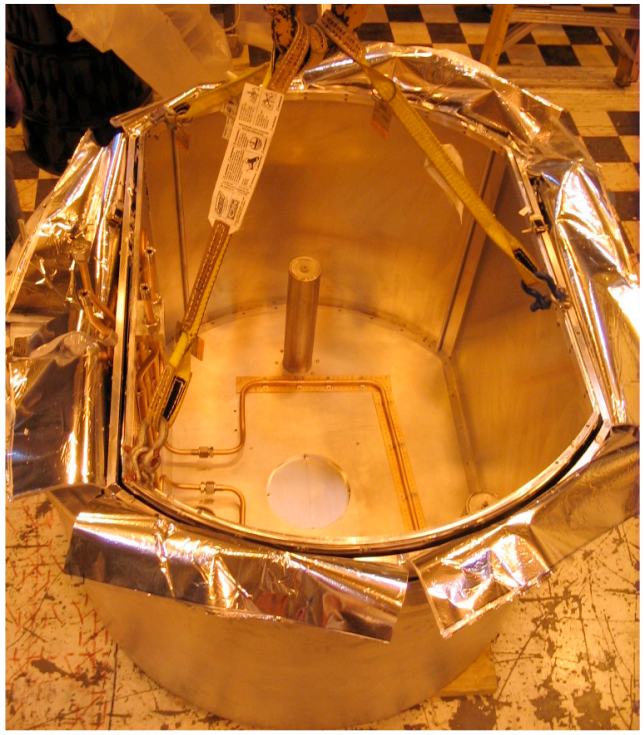
- LHe dewar and heat shield panels are covered with MLI blanket.
- Temperature sensors and velcro fasteners are glued on the heat shield panels.
- Test fitting of the dewar to the cryostat (no major issues found)
- Installation of the pressure relief vent pipe to the dewar. (only the 4k shield top plate is shown here)



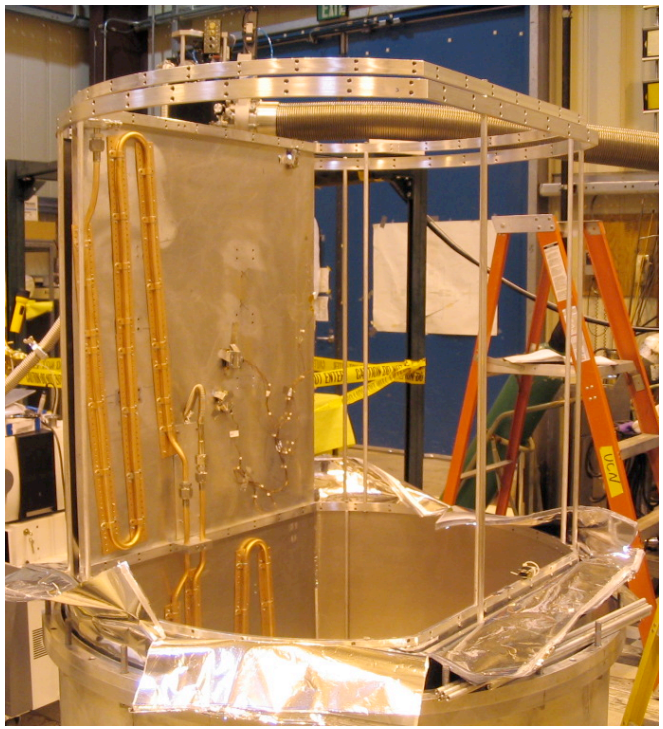
Assembling the cryostat (3)

- 4k and 50k shield bottom parts were assembled separately, and 4k shield was installed inside 50k shield

Installation of 4k & 50k bottom shields into the bottom can



Build part of the middle heat shields (rings, rods, panels)



May 2008

Other things in progress

1. Will insert a helium gas line (consists of copper tubing, ss bellows, and VCR fittings) inside the cryostat from one of the top flanges. Helium boil-off gas flows through it. That is used to cool the bottom of DR.

2. The citical lift IWD needs to be approved to lift the DR.

3. Plan to use two scaffoldings and unistrut bars when a top or middle cryostat can is removed from (or inserted in) the assembly (needs approval)

List of things to do / Timeline

1. After critical lift IWD is approved, insert the DR into the LHe dewar. Make indium seal and do leak check (~1 week)
2. Assemble the whole cryostat and do leak check [1~2 weeks]
3. Cooling test (without using DR) [1 week or more]
4. Cooling test (with DR) [2 weeks or more]

5. Install HV system and perform R&D
6. Install 3He system and perform injection test.

Summary

- Made and installed new cooling lines for heat shields
- Safety document for the cooling tests has been approved.
- Started assembling the whole cryostat to prepare for the cooling tests. Perform leak check as we assemble it.
- Will start the cooling tests next month.

- Important to finish the cryostat work as soon as possible because HV and 3He R&D need to be done.